

PATENT ABSTRACTS OF JAPAN

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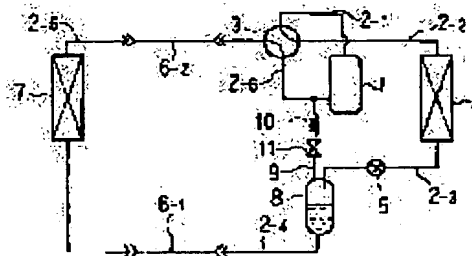
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(54) AIR CONDITIONER

(57)Abstract:

PURPOSE: To eliminate a decrease in capacity due to an increase in a pressure loss in a tube by providing a gas/air separator for connecting an indoor heat exchanger at a lower part between a pressure reducing unit and an indoor heat exchanger and connecting at its upper part to a suction side of a compressor through a switching valve and a capillary tube.

CONSTITUTION: A gas/liquid separator 8 is provided between a first pressure reducing unit 5 and an indoor heat exchanger 7, and a connecting piping 9 to be guided to a suction piping 2-6 of a compressor 1 is provided through a connecting piping 2-4 to be guided from a lower part of the separator 8 into the exchanger 7 and a connecting piping 9 to be guided from an upper part of the separator 8 through a capillary tube 10 and a switching valve 11 to the piping 2-6 of the compressor 1. Liquid refrigerant condensed by an outdoor heat exchanger 4 is expanded by the unit 5 to become two-phase refrigerant of low temperature and low pressure, and separated to saturated liquid and saturated gas by the separator 8. The saturated liquid refrigerant is guided to the exchanger 7, evaporated, and returned to the compressor 1. The saturated gas refrigerant is reduced under pressure by the tube 10 through the tube 9 by opening the valve 11, and returned to the compressor 1.



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CLAIMS

[Claim(s)]

[Claim 1] The air conditioner which the upper part equipped with the vapor-liquid-separation machine connected to the inlet side of said compressor through a closing motion valve and a KYABI rally tube while it was prepared between said decompression devices and indoor heat exchangers and the lower part connected with said indoor heat exchanger in the air conditioner which has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, indoor heat exchanger, etc. to annular one by one.

[Claim 2] In the air conditioner which has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, the 1st decompression device, indoor heat exchanger, etc. to annular one by one Said outdoor heat exchanger and the heat exchanger for supercooling prepared between the 1st decompression device, The air conditioner equipped with the 1st connection piping which branches from between this heat exchanger for supercooling, and said 1st decompression device, and is connected to said heat exchanger for supercooling through the 2nd decompression device, and the 2nd connection piping connected to the inlet side of said compressor from said heat exchanger for supercooling.

[Claim 3] The air conditioner according to claim 2 equipped with the 3rd decompression device between the outdoor heat exchanger and the heat exchanger for supercooling.

[Claim 4] The air conditioner [equipped with the pressure sensor and thermometric element which were formed in the unification section of the 2nd connection piping and the inlet side of a compressor, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value] according to claim 2.

[Claim 5] The air conditioner [equipped with the thermometric element formed in the unification section of the 2nd connection piping and the inlet side of a compressor, the 1st connection piping and the 2nd thermometric element prepared for the connection of the heat exchanger for supercooling, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value] according to claim 2.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is the air conditioner and the thing especially about that improvement in the engine performance which were divided into the interior unit and the exterior unit.

[0002]

[Description of the Prior Art] Drawing 11 shows the refrigerant circuit of the conventional air conditioner. In drawing, 1 is a compressor and this compressor 1 is connected with the four-way valve 3 through the 1st piping 2-1 (regurgitation piping of a compressor 1). This four-way valve 3 is connected with the outdoor heat exchanger 4 through the 2nd piping 2-2. This outdoor heat exchanger 4 is connected with the decompression device 5 through the 3rd piping 2-3. This decompression device 5 is connected with indoor heat exchanger 6 through the extended piping 6-1 which connects the 4th piping 2-4 and interior unit, and exterior unit (not shown). This indoor heat exchanger 7 is connected with said four-way valve 3 through the extended piping 6-2 which connects the 5th piping 2-5 and interior unit, and exterior unit (not shown). 2-6 in drawing is piping (inhalation piping of a compressor 1) with which the 1st piping 2-1 connects independently said compressor 1 and four-way valve 3.

[0003] Next, actuation is explained. At the time of cooling operation, a refrigerant is compressed with a compressor 1. The 1st piping 2-1 (regurgitation piping of a compressor 1), It is sent to an outdoor heat exchanger 4 through a four-way valve 3 and the 2nd piping 2-2, and is condensed here. It is sent to a decompression device 5 through the 3rd piping 2-3, is sent to indoor heat exchanger 6 here through a rat tail, the 4th piping 2-4, and the extended piping 6-1, and evaporates here. It returns to a compressor 1 through the 5th piping 2-5, the extended piping 6-2, a four-way valve 3, and the 6th piping 2-6 (regurgitation piping of a compressor 1), and is compressed again.

[0004] At the time of heating operation, a refrigerant is compressed with a compressor 1, and it is sent to indoor heat exchanger 7 through the 1st piping 2-1, a four-way valve 3, the extended piping 6-2, and the 5th piping 2-5, and is condensed here. It is sent to a decompression device 5 through the extended piping 6-1 and the 4th piping 2-4, is sent to an outdoor heat exchanger 4 through a rat tail and the 3rd piping 2-3 here, evaporates here, returns to a compressor 1 through the 2nd piping 2-2, a four-way valve 3, and the 6th piping 2-6, and is compressed again.

[0005]

[Problem(s) to be Solved by the Invention] Since the conventional air conditioner is constituted as mentioned above, when the distance of an interior unit and an exterior unit is separated and the extended piping 6 becomes long, or when the difference of elevation of an interior unit and an exterior unit is large, as shown in drawing 12 Tubing internal pressure loss (ΔP of drawing 12) of a refrigerant increased, the amount into which a compressor 1 compresses a refrigerant since the consistency of the refrigerant absorbed by the compressor 1 becomes small decreased, and there was a trouble that cooling capacity will decline substantially as a result.

[0006] It was made in order that this invention might solve the above troubles, and it aims at offering the air conditioner which canceled the capacity lowering by buildup of tubing internal

pressure loss.

[0007]

[Means for Solving the Problem] The upper part is equipped with the vapor-liquid-separation machine connected to the inlet side of said compressor through a closing motion valve and a KYABI rally tube, while the air conditioner of claim 1 is prepared between said decompression devices and indoor heat exchangers in the air conditioner which has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, indoor heat exchanger, etc. to annular one by one and the lower part connects with said indoor heat exchanger.

[0008] In the air conditioner in which the air conditioner of claim 2 has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, the 1st decompression device, indoor heat exchanger, etc. to annular one by one Said outdoor heat exchanger and the heat exchanger for supercooling prepared between the 1st decompression device, It branches from between this heat exchanger for supercooling, and said 1st decompression device, and has the 1st connection piping connected to said heat exchanger for supercooling through the 2nd decompression device, and the 2nd connection piping connected to the inlet side of said compressor from said heat exchanger for supercooling.

[0009] The air conditioner of claim 3 is equipped with the 3rd decompression device between an outdoor heat exchanger and the heat exchanger for supercooling in an air conditioner according to claim 2.

[0010] The air conditioner of claim 4 is equipped with the pressure sensor and thermometric element which were formed in the unification section of the 2nd connection piping and the inlet side of a compressor, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value, in an air conditioner according to claim 2.

[0011] The air conditioner of claim 5 is equipped with the thermometric element formed in the unification section of the 2nd connection piping and the inlet side of a compressor, the 1st connection piping and the 2nd thermometric element prepared for the connection of the heat exchanger for supercooling, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value, in an air conditioner according to claim 2.

[0012]

[Function] Since the air conditioner of claim 1 sends only the liquid separated with the vapor-liquid-separation vessel to indoor heat exchanger, it prevents lowering of cooling capacity by securing a refrigerating effect while it prevents buildup of tubing internal pressure loss by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended piping.

[0013] While the air conditioner of claim 2 supercools further the liquid cooling intermediation which passed through the outdoor heat exchanger by the heat exchanger for supercooling and making a refrigerating effect increase By cooling the liquid cooling intermediation which it branches, and some supercooling liquid which passed through the heat exchanger for supercooling was expanded, and passed through the outdoor heat exchanger, and returning to a compressor While preventing buildup of tubing internal pressure loss by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended piping, lowering of cooling capacity is prevented by securing a refrigerating effect.

[0014] The air conditioner of claim 3 cools liquid cooling intermediation by branching, expanding a part of liquid cooling intermediation which passed through indoor heat exchanger, and leading to the heat exchanger for supercooling, and returns it to a compressor, and since liquid cooling intermediation is supercooled by the heat exchanger for supercooling, while it can make a refrigerating effect increase, by suppressing the rate of flow of the refrigerant which flows an outdoor heat exchanger, it can prevent buildup of tubing internal pressure loss, and can prevent lowering of heating capacity.

[0015] By detecting the pressure and temperature of the unification section of the 2nd connection piping and the inlet side of a compressor, the air conditioner of claim 4 can prevent

the liquid back to a compressor, and its dependability of a compressor improves.

[0016] By detecting the temperature of the unification section with inhalation piping of piping connected to inhalation piping of a compressor from the temperature and the heat exchanger for supercooling of the refrigerant which expanded with the decompression device, cheaply and easily, the air conditioner of claim 5 can prevent the liquid back to a compressor, and its dependability of a compressor improves.

[0017]

[Example]

The example 1 of this invention is explained about drawing below example 1. In drawing 1, 8 is the vapor-liquid-separation machine formed between the 1st decompression device 5 and indoor heat exchanger 7, and connection piping for which piping 2-4 is led to indoor heat exchanger 7 from the lower part of the vapor-liquid-separation machine 8, and piping 9 are connection piping led to the inhalation piping 2-6 of a compressor 1 through the KYABI rally tube 10 and the closing motion valve 11 from the upper part of the vapor-liquid-separation machine 8.

[0018] Next, actuation is explained. At the time of cooling operation, the liquid cooling intermediation condensed by the outdoor heat exchanger 4 expands with a decompression device 5, turns into low temperature and a low-pressure two phase refrigerant, and is separated into a saturated liquid and saturated gas by the vapor-liquid-separation machine 8. A saturated liquid refrigerant is led to indoor heat exchanger 7 through piping 2-4 and the extended piping 6-1, evaporates here, and is returned to a compressor 1 through piping 2-5, the extended piping 6-2, and piping 2-6. A saturated gas refrigerant is decompressed by open Lycium chinense with the KYABI rally tube 10 through piping 9, and the closing motion valve 11 is returned to a compressor 1 by it.

[0019] The Mollier chart of drawing 2 explains the above-mentioned actuation. The condition of the refrigerant which came out of the decompression device 5 can be expressed with a points, the saturated liquid separated with the vapor-liquid-separation vessel 8 can be expressed with b points, and saturated gas can be expressed with c points. The rate of flow of the refrigerant which flows indoor heat exchanger 7 and the extended piping 6 is suppressed, and only the part of the saturated gas separated with the vapor-liquid-separation vessel 8 can fall tubing internal pressure loss. Although the refrigerant flow rate which flows indoor heat exchanger 7 decreases, since the inlet-port section of indoor heat exchanger 7 serves as a saturated liquid as shown in drawing 2, a large refrigerating effect (enthalpy difference) can be taken compared with the conventional refrigerating cycle, and cooling capacity is secured.

[0020] Since only the liquid separated with the vapor-liquid-separation vessel was sent to indoor heat exchanger (evaporator), the air conditioner in an example 1 prevents lowering of cooling capacity by securing a refrigerating effect (enthalpy difference) while it prevents buildup of tubing internal pressure loss by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended piping. It is effective in especially a refrigerant with the small consistency in low voltage especially like the HFC-134a refrigerant which is one of the alternative refrigerants of HCFC-22 refrigerant.

[0021] example 2. -- the example 2 of this invention is explained using drawing 3. In drawing 3, 12 is an outdoor heat exchanger 4 and the heat exchanger for supercooling arranged between the 1st decompression device 5, and the 1st connection piping which piping 13 branches from piping 2-4, and is connected to the heat exchanger 12 for supercooling through the 2nd decompression device 14, and piping 15 are 2nd connection piping led to the inhalation piping 2-6 of a compressor 1 from the heat exchanger 12 for supercooling.

[0022] Next, actuation is explained. At the time of cooling operation, it is further cooled by the heat exchanger 12 for supercooling, and the liquid cooling intermediation condensed by the outdoor heat exchanger 4 is led to a rat tail and indoor heat exchanger 7 by the 1st decompression device 5 through piping 2-4 and the extended piping 6-1, evaporates here, and is returned to a compressor 1 through piping 2-5, the extended piping 6-2, and piping 2-6. Moreover, some supercooling liquid which branched from piping 2-4 cools the liquid cooling intermediation condensed by the 2nd decompression device 14 by the outdoor heat exchanger 4 with the rat tail and the heat exchanger 12 for supercooling, and it is returned to a compressor

1.

[0023] The Mollier chart of drawing 4 explains the above-mentioned actuation. The condition of the refrigerant which came out of the outdoor heat exchanger 4 is expressed with d points, the condition of the refrigerant cooled by the heat exchanger 12 for supercooling is expressed with e points, f points are in the inlet-port condition of an outdoor heat exchanger 4 and the heat exchanger 12 for supercooling, and g points are in the inhalation condition of a compressor 1. The rate of flow of the refrigerant which flows indoor heat exchanger 7 and the extended piping 6 is suppressed, and only the part of the refrigerant which branched to the heat exchanger 12 for supercooling can fall tubing internal pressure loss. Although the refrigerant flow rate which flows indoor heat exchanger 7 decreases, as shown in drawing 4, only the part of supercooling can take a large refrigerating effect (enthalpy difference) compared with the conventional refrigerating cycle, and cooling capacity is secured.

[0024] While the air conditioner of an example 2 supercools further the liquid cooling intermediation which passed through the outdoor heat exchanger by the heat exchanger for supercooling and making a refrigerating effect (enthalpy difference) increase By cooling the liquid cooling intermediation which it branches, and some supercooling liquid which passed through the heat exchanger for supercooling was expanded, and passed through the outdoor heat exchanger, and returning to a compressor, by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended piping, buildup of tubing internal pressure loss can be prevented and lowering of cooling capacity is prevented. It is effective in especially a refrigerant with the small consistency in low voltage especially like the HFC-134a refrigerant which is one of the alternative refrigerants of HCFC-22 refrigerant.

[0025] example 3. -- the example 3 of this invention is explained using drawing 5 R> 5. Drawing 5 arranges the 3rd decompression device 16 between an outdoor heat exchanger 4 and the heat exchanger 12 for supercooling in an example 2.

[0026] Next, actuation is explained. At the time of heating operation, it is further cooled by the heat exchanger 12 for supercooling, and the liquid cooling intermediation condensed by indoor heat exchanger 7 is led to a rat tail and an outdoor heat exchanger 4 by the 3rd decompression device 16, evaporates here, and is returned to a compressor 1. Moreover, a part of liquid cooling intermediation which branched from piping 2-4 cools the liquid cooling intermediation condensed by the 2nd decompression device by indoor heat exchanger 7 with the rat tail and the heat exchanger 12 for supercooling, and it is returned to a compressor 1.

[0027] The Mollier chart of drawing 6 explains the above-mentioned actuation. The condition of the refrigerant which came out of indoor heat exchanger 7 is expressed with h points, the condition of the refrigerant cooled by the heat exchanger 12 for supercooling is expressed with i points, j points are the inlet-port condition of an outdoor heat exchanger 4, and k points are the inlet-port condition of the heat exchanger 12 for supercooling, and L. A point is in the inhalation condition of a compressor 1. The rate of flow of the refrigerant which flows an outdoor heat exchanger 4 is suppressed, and only the part of the refrigerant which branched to the heat exchanger 12 for supercooling can fall tubing internal pressure loss. Although the refrigerant flow rate which flows an outdoor heat exchanger 4 decreases, as shown in drawing 6, only the part of supercooling can take a large refrigerating effect (enthalpy difference) compared with the conventional refrigerating cycle, and heating capacity is secured.

[0028] Moreover, said liquid cooling intermediation is cooled by leading to the heat exchanger for supercooling which it branches [heat exchanger] and expands a part of liquid cooling intermediation which passed through indoor heat exchanger, and it returns to a compressor, and since said liquid cooling intermediation is supercooled by the heat exchanger for supercooling, while being able to make a refrigerating effect (enthalpy difference) increase, by suppressing the rate of flow of the refrigerant which flows to an outdoor heat exchanger, buildup of tubing internal pressure loss can be prevented and lowering of heating capacity is prevented. It is effective in especially a refrigerant with the small consistency in low voltage especially like the HFC-134a refrigerant which is one of the alternative refrigerants of HCFC-22 refrigerant.

[0029] example 4. -- the example 4 of this invention is explained using drawing 7 R> 7. In an example 2, the unification section of the 2nd connection piping 15 and the inhalation piping 2-6

of a compressor 1 led to the inhalation piping 2-6 of a compressor 1 from the heat exchanger 12 for supercooling is equipped with a pressure sensor 17 and a thermometric element 18.

[0030] Next, actuation is explained in drawing 7 and drawing 8. In case some supercooling liquid which branched from piping 2-4 cools the liquid cooling intermediation condensed by the 2nd decompression device 14 by the outdoor heat exchanger 4 with the rat tail and the heat exchanger 12 for supercooling and it is returned to a compressor 1, the drawing opening of the 2nd decompression device 14 is controlled so that the degree of superheat of the pressure detected by said pressure sensor 17 and thermometric element 18 and the refrigerant computed from temperature serves as desired value. As mentioned above, while being able to prevent the liquid back to a compressor 1 and being able to aim at improvement in dependability by adjusting the flow rate of the refrigerant which branches from piping 2-4, the effectiveness of a refrigerating cycle also improves.

[0031] As mentioned above, according to the example 4, by detecting the pressure and temperature of the unification section with inhalation piping of piping which were connected to inhalation piping of a compressor 1 from the heat exchanger 12 for supercooling, the liquid back to a compressor 1 can be prevented and the dependability of a compressor 1 improves.

[0032] example 5. -- the example 5 of this invention is explained using drawing 9 R> 9. In an example 2, the unification section of the 2nd connection piping 15 and the inhalation piping 2-6 of a compressor 1 to which the 2nd thermometric element 19 is led from the heat exchanger 12 for supercooling by the part connected to the heat exchanger 12 for supercooling of the 1st connection piping 13 to the inhalation piping 2-6 of a compressor 1 is equipped with the 1st thermometric element 18.

[0033] Next, actuation is explained in drawing 9 and drawing 10. The drawing opening of the 2nd decompression device 14 is controlled so that the degree of superheat of the refrigerant computed from the saturation temperature of the refrigerant detected by the 2nd thermometric element 19 and the temperature detected by the 1st thermometric element 18 serves as desired value. As mentioned above, while being able to prevent the liquid back to a compressor 1 and being able to aim at improvement in dependability easily by using cheap thermometric elements (for example, thermistor etc.), the effectiveness of a refrigerating cycle also improves.

[0034] According to this example 5, by detecting the temperature of the unification section with inhalation piping of piping connected to inhalation piping of a compressor from the temperature and the heat exchanger for supercooling of the refrigerant which expanded with the decompression device, it is cheap, the liquid back to a compressor can be prevented, and the dependability of a compressor improves.

[0035]

[Effect of the Invention] In the air conditioner in which the air conditioner of claim 1 has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, indoor heat exchanger, etc. to annular one by one While it is prepared between said decompression devices and indoor heat exchangers and the lower part connects with said indoor heat exchanger Since the upper part made it the configuration equipped with the vapor-liquid-separation machine connected to the inlet side of said compressor through a closing motion valve and a KYABI rally tube While preventing buildup of tubing internal pressure loss by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended piping, lowering of cooling capacity is prevented by securing a refrigerating effect.

[0036] In the air conditioner in which the air conditioner of claim 2 has the refrigerant circuit which connected a compressor, a four-way valve, an outdoor heat exchanger, the 1st decompression device, indoor heat exchanger, etc. to annular one by one Said outdoor heat exchanger and the heat exchanger for supercooling prepared between the 1st decompression device, The 1st connection piping which branches from between this heat exchanger for supercooling, and said 1st decompression device, and is connected to said heat exchanger for supercooling through the 2nd decompression device, Since it was made the configuration equipped with the 2nd connection piping connected to the inlet side of said compressor from said heat exchanger for supercooling, while preventing buildup of tubing internal pressure loss by suppressing the rate of flow of the refrigerant which flows indoor heat exchanger and extended

piping, lowering of cooling capacity is prevented by securing a refrigerating effect.

[0037] In an air conditioner according to claim 2, since the air conditioner of claim 3 was made the configuration equipped with the 3rd decompression device between the outdoor heat exchanger and the heat exchanger for supercooling, by suppressing the rate of flow of the refrigerant which flows an outdoor heat exchanger, it can prevent buildup of tubing internal pressure loss, and can prevent lowering of heating capacity.

[0038] In an air conditioner according to claim 2, since the air conditioner of claim 4 was made the configuration equipped with the pressure sensor and thermometric element which were formed in the unification section of the 2nd connection piping and the inlet side of a compressor, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value, it can prevent the liquid back to a compressor and its dependability of a compressor improves.

[0039] The thermometric element with which the air conditioner of claim 5 was prepared in the unification section of the 2nd connection piping and the inlet side of a compressor in the air conditioner according to claim 2, Since it was made the configuration equipped with the 1st connection piping, the 2nd thermometric element prepared for the connection of the heat exchanger for supercooling, and a means to adjust the opening of the 2nd decompression device so that the refrigerant degree of superheat of said unification section may become desired value Cheaply and easily, the liquid back to a compressor can be prevented and the dependability of a compressor improves.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is refrigerant circuit drawing of the example 1 by this invention.

[Drawing 2] It is the Mollier chart showing actuation of the example 1 by this invention.

[Drawing 3] It is refrigerant circuit drawing of the example 2 by this invention.

[Drawing 4] It is the Mollier chart showing actuation of the example 2 by this invention.

[Drawing 5] It is refrigerant circuit drawing of the example 3 by this invention.

[Drawing 6] It is the Mollier chart showing actuation of the example 3 by this invention.

[Drawing 7] It is refrigerant circuit drawing of the example 4 by this invention.

[Drawing 8] It is flow chart drawing of the example 4 by this invention.

[Drawing 9] It is refrigerant circuit drawing of the example 5 by this invention.

[Drawing 10] It is flow chart drawing of the example 5 by this invention.

[Drawing 11] It is refrigerant circuit drawing of the conventional air conditioner.

[Drawing 12] It is the Mollier chart showing actuation of the conventional air conditioner.

[Description of Notations]

1 Compressor

2 Refrigerant Piping

3 Four-way Valve

- 4 Outdoor Heat Exchanger
- 5 1st Decompression Device
- 6 Extended Piping
- 7 Indoor Heat Exchanger
- 8 Vapor-Liquid-Separation Machine
- 9 Connection Piping
- 10 KYABI Rally Tube
- 11 Closing Motion Valve
- 12 Heat Exchanger for Supercooling
- 13 1st Connection Piping
- 14 2nd Decompression Device
- 15 2nd Connection Piping
- 16 3rd Decompression Device
- 17 Pressure Sensor
- 18 1st Thermometric Element
- 19 2nd Thermometric Element

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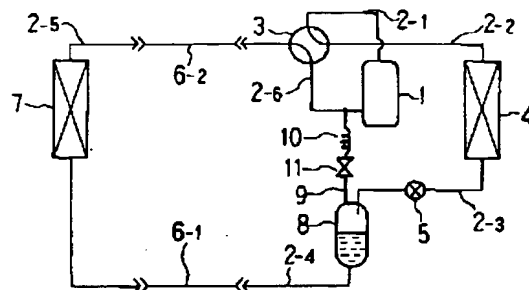
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(54)【発明の名称】 空気調和機

(57)【要約】

【構成】 圧縮機1、四方弁3、室外熱交換器4、減圧装置5、室内熱交換器7等を順次環状に接続した冷媒回路を有する空気調和機において、前記減圧装置5と室内熱交換器7の間に設けられ、その下部が前記室内熱交換器7に接続すると共に、上部が開閉弁11及びキャピラリーチューブ10を介して前記圧縮機1の吸入側に接続する気液分離器8を備える。

【効果】 室内熱交換器7及び延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果を確保することにより、冷房能力の低下を防止する。



1: 圧縮機	5: 第1の減圧装置	9: 連結配管
2: 冷媒配管	6: 延長配管	10: キャピラリーチューブ
3: 四方弁	7: 室内熱交換器	11: 開閉弁
4: 室外熱交換器	8: 気液分離器	

【特許請求の範囲】

【請求項1】 圧縮機、四方弁、室外熱交換器、減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記減圧装置と室内熱交換器の間に設けられ、その下部が前記室内熱交換器に接続すると共に、上部が開閉弁及びキャピラリーチューブを介して前記圧縮機の吸入側に接続する気液分離器を備えた空気調和機。

【請求項2】 圧縮機、四方弁、室外熱交換器、第1の減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記室外熱交換器と第1の減圧装置の間に設けられた過冷却用熱交換器と、この過冷却用熱交換器と前記第1の減圧装置の間から分岐し、第2の減圧装置を介して前記過冷却用熱交換器へ接続される第1の連結配管と、前記過冷却用熱交換器から前記圧縮機の吸入側に接続される第2の連結配管と、を備えた空気調和機。

【請求項3】 室外熱交換器と過冷却用熱交換器の間に第3の減圧装置を備えた請求項2記載の空気調和機。

【請求項4】 第2の連結配管と圧縮機の吸入側との合流部に設けられた圧力検出器及び温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えた請求項2記載の空気調和機。

【請求項5】 第2の連結配管と圧縮機の吸入側との合流部に設けられた温度検出器と、第1の連結配管と過冷却用熱交換器の接続部に設けられた第2の温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えた請求項2記載の空気調和機。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 この発明は、室内機と室外機に分離された空気調和機、特にその性能向上に関するものである。

【0002】

【従来の技術】 図11は従来の空気調和機の冷媒回路を示すものである。図において、1は圧縮機であり、この圧縮機1は第1の配管2-1（圧縮機1の吐出配管）を介して四方弁3に連結している。この四方弁3は第2の配管2-2を介して室外熱交換器4に連結している。この室外熱交換器4は第3の配管2-3を介して減圧装置5に連結している。この減圧装置5は第4の配管2-4および室内機と室外機（図示せず）を接続する延長配管6-1を介して室内熱交換器6に連結している。この室内熱交換器7は第5の配管2-5および室内機と室外機（図示せず）を接続する延長配管6-2を介して前記四方弁3に連結している。図中の2-6は前記圧縮機1と四方弁3を第1の配管2-1とは別につなぐ配管（圧縮機1の吸入配管）である。

【0003】 次に動作について説明する。冷房運転時には冷媒は圧縮機1で圧縮され、第1の配管2-1（圧縮機1の吐出配管）、四方弁3、第2の配管2-2を経て室外熱交換器4に送られてここで凝縮され、第3の配管2-3を経て減圧装置5に送られここで絞られ、第4の配管2-4および延長配管6-1を経て室内熱交換器6に送られここで蒸発し、第5の配管2-5、延長配管6-2、四方弁3、第6の配管2-6（圧縮機1の吐出配管）を介して圧縮機1に戻り、再び圧縮される。

【0004】 暖房運転時には冷媒は圧縮機1で圧縮され、第1の配管2-1、四方弁3、延長配管6-2、第5の配管2-5を経て室内熱交換器7に送られてここで凝縮され、延長配管6-1、第4の配管2-4を経て減圧装置5に送られここで絞られ、第3の配管2-3を経て室外熱交換器4に送られここで蒸発し、第2の配管2-2、四方弁3、第6の配管2-6を介して圧縮機1に戻り、再び圧縮される。

【0005】

【発明が解決しようとする課題】 従来の空気調和機は以上のように構成されているので、室内機と室外機の距離が離れており延長配管6が長くなる場合や、室内機と室外機の高低差が大きい場合、図12に示すように、冷媒の管内圧損（図12の ΔP ）が増大し、圧縮機1に吸い込まれる冷媒の密度が小さくなるため、圧縮機1が冷媒を圧縮する量が減少し、その結果冷房能力が大幅に低下してしまうという問題点があった。

【0006】 この発明は上記のような問題点を解決するためになされたもので、管内圧損の増大による能力低下を解消した空気調和機を提供することを目的とする。

【0007】

【課題を解決するための手段】 請求項1の空気調和機は、圧縮機、四方弁、室外熱交換器、減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記減圧装置と室内熱交換器の間に設けられ、その下部が前記室内熱交換器に接続すると共に、上部が開閉弁及びキャピラリーチューブを介して前記圧縮機の吸入側に接続する気液分離器を備えたものである。

【0008】 請求項2の空気調和機は、圧縮機、四方弁、室外熱交換器、第1の減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記室外熱交換器と第1の減圧装置の間に設けられた過冷却用熱交換器と、この過冷却用熱交換器と前記第1の減圧装置の間から分岐し、第2の減圧装置を介して前記過冷却用熱交換器へ接続される第1の連結配管と、前記過冷却用熱交換器から前記圧縮機の吸入側に接続される第2の連結配管と、を備えたものである。

【0009】 請求項3の空気調和機は、請求項2記載の空気調和機において、室外熱交換器と過冷却用熱交換器の間に第3の減圧装置を備えたものである。

【0010】請求項4の空気調和機は、請求項2記載の空気調和機において、第2の連結配管と圧縮機の吸入側との合流部に設けられた圧力検出器及び温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えたものである。

【0011】請求項5の空気調和機は、請求項2記載の空気調和機において、第2の連結配管と圧縮機の吸入側との合流部に設けられた温度検出器と、第1の連結配管と過冷却用熱交換器の接続部に設けられた第2の温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えたものである。

【0012】

【作用】請求項1の空気調和機は、気液分離器により分離された液のみを室内熱交換器に送るので、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果を確保することにより、冷房能力の低下を防止する。

【0013】請求項2の空気調和機は、室外熱交換器を経た液冷媒をさらに過冷却用熱交換器により過冷却し、冷凍効果を増加させると共に、過冷却用熱交換器を経た過冷却液の一部を分岐して膨張させ室外熱交換器を経た液冷媒を冷却して圧縮機へ戻すことにより、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果を確保することにより、冷房能力の低下を防止する。

【0014】請求項3の空気調和機は、室内熱交換器を経た液冷媒の一部を分岐して膨張させ過冷却用熱交換器へ導くことにより液冷媒を冷却して圧縮機に戻し、液冷媒は過冷却用熱交換器により過冷却されるため冷凍効果を増加させることができると共に、室外熱交換器を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐことができ、暖房能力の低下を防止できる。

【0015】請求項4の空気調和機は、第2の連結配管と圧縮機の吸入側との合流部の圧力と温度を検出することにより、圧縮機への液バックを防ぐことができ、圧縮機の信頼性が向上する。

【0016】請求項5の空気調和機は、減圧装置により膨張された冷媒の温度と過冷却用熱交換器から圧縮機の吸入配管へ接続された配管の吸入配管との合流部の温度を検出することにより、安価で容易に、圧縮機への液バックを防ぐことができ、圧縮機の信頼性が向上する。

【0017】

【実施例】

実施例1. 以下、本発明の実施例1を図について説明する。図1において、8は第1の減圧装置5と室内熱交換器7の間に設けられた気液分離器であり、配管2-4は気液分離器8の下部から室内熱交換器7へ導かれる連結配管、配管9は気液分離器8の上部からキャピラリーチューブ10および開閉弁11を介して圧縮機1の吸入配

管2-6へ導かれる連結配管である。

【0018】次に動作について説明する。冷房運転時、室外熱交換器4により凝縮された液冷媒は減圧装置5により膨張され低温・低圧の二相冷媒となり、気液分離器8により飽和液と飽和ガスに分離される。飽和液冷媒は配管2-4および延長配管6-1を介して室内熱交換器7に導かれここで蒸発し、配管2-5、延長配管6-2、配管2-6を介して圧縮機1へ戻される。飽和ガス冷媒は開閉弁11を開くことにより、配管9を通りキャピラリーチューブ10により減圧され圧縮機1へ戻される。

【0019】上記動作を図2のモリエル線図で説明する。減圧装置5を出た冷媒の状態はa点で表され、気液分離器8で分離された飽和液はb点、飽和ガスはc点で表せる。気液分離器8で分離された飽和ガスの分だけ室内熱交換器7および延長配管6を流れる冷媒の流速が抑えられ管内圧損を低下できる。室内熱交換器7を流れる冷媒流量は減少するが、図2に示すように室内熱交換器7の入口部が飽和液となるため、従来の冷凍サイクルに比べ冷凍効果（エンタルピ差）が大きく取れ、冷房能力が確保される。

【0020】実施例1における空気調和機は、気液分離器により分離された液のみを室内熱交換器（蒸発器）に送るようにしたため、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果（エンタルピ差）を確保することにより、冷房能力の低下を防止する。特に、HFC-22冷媒の代替冷媒の一つであるHFC-134a冷媒のように低圧での密度が小さい冷媒には特に有効である。

【0021】実施例2. この発明の実施例2について、図3を用いて説明する。図3において、12は室外熱交換器4と第1の減圧装置5の間に配設された過冷却用熱交換器であり、配管13は配管2-4から分岐し第2の減圧装置14を介して過冷却用熱交換器12へ接続される第1の連結配管、配管15は過冷却用熱交換器12から圧縮機1の吸入配管2-6へ導かれる第2の連結配管である。

【0022】次に動作について説明する。冷房運転時、室外熱交換器4により凝縮された液冷媒は過冷却用熱交換器12によりさらに冷却され、配管2-4および延長配管6-1を介して第1の減圧装置5により絞られ、室内熱交換器7に導かれここで蒸発し、配管2-5、延長配管6-2、配管2-6を介して圧縮機1へ戻される。また、配管2-4より分岐された過冷却液の一部は第2の減圧装置14により絞られ、過冷却用熱交換器12により室外熱交換器4により凝縮された液冷媒を冷却し、圧縮機1へ戻される。

【0023】上記動作を図4のモリエル線図で説明する。室外熱交換器4を出た冷媒の状態はd点で表され、過冷却用熱交換器12により冷却された冷媒の状態はe

点で表され、f 点は室外熱交換器 4 および過冷却用熱交換器 12 の入口状態、g 点は圧縮機 1 の吸入状態である。過冷却用熱交換器 12 に分岐された冷媒の分だけ室内熱交換器 7 および延長配管 6 を流れる冷媒の流速が抑えられ管内圧損を低下できる。室内熱交換器 7 を流れる冷媒流量は減少するが、図 4 に示すように過冷却の分だけ、従来の冷凍サイクルに比べ冷凍効果（エンタルピ差）が大きく取れ、冷房能力が確保される。

【0024】実施例 2 の空気調和機は、室外熱交換器を経た液冷媒をさらに過冷却用熱交換器により過冷却し、冷凍効果（エンタルピ差）を増加させると共に、過冷却用熱交換器を経た過冷却液の一部を分岐して膨張させ室外熱交換器を経た液冷媒を冷却して圧縮機へ戻すことにより、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐことができ、冷房能力の低下を防止する。特に、HCFC-22 冷媒の代替冷媒の一つである HFC-134a 冷媒のように低圧での密度が小さい冷媒には特に有効である。

【0025】実施例 3. この発明の実施例 3 について図 5 を用いて説明する。図 5 は実施例 2 において室外熱交換器 4 と過冷却用熱交換器 12 の間に第 3 の減圧装置 16 を配設したものである。

【0026】次に動作について説明する。暖房運転時、室内熱交換器 7 により凝縮された液冷媒は過冷却用熱交換器 12 によりさらに冷却され、第 3 の減圧装置 16 により絞られ、室外熱交換器 4 に導かれここで蒸発し、圧縮機 1 へ戻される。また、配管 2-4 より分岐された液冷媒の一部は第 2 の減圧装置により絞られ、過冷却用熱交換器 12 により、室内熱交換器 7 により凝縮された液冷媒を冷却し、圧縮機 1 へ戻される。

【0027】上記動作を図 6 のモリエル線図で説明する。室内熱交換器 7 を出た冷媒の状態は h 点で表され、過冷却用熱交換器 12 により冷却された冷媒の状態は i 点で表され、j 点は室外熱交換器 4 の入口状態、k 点は過冷却用熱交換器 12 の入口状態、l 点は圧縮機 1 の吸入状態である。過冷却用熱交換器 12 に分岐された冷媒の分だけ室外熱交換器 4 を流れる冷媒の流速が抑えられ管内圧損を低下できる。室外熱交換器 4 を流れる冷媒流量は減少するが、図 6 に示すように過冷却の分だけ、従来の冷凍サイクルに比べ冷凍効果（エンタルピ差）が大きく取れ、暖房能力が確保される。

【0028】また、室内熱交換器を経た液冷媒の一部を分岐して膨張させる過冷却用熱交換器へ導くことにより前記液冷媒を冷却して圧縮機へ戻し、前記液冷媒は過冷却用熱交換器により過冷却されるため冷凍効果（エンタルピ差）を増加させることができると共に、室外熱交換器に流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐことができ、暖房能力の低下を防止する。特に、HCFC-22 冷媒の代替冷媒の一つである HFC-134a 冷媒のように低圧での密度が小さい冷媒には

特に有効である。

【0029】実施例 4. この発明の実施例 4 について図 7 を用いて説明する。実施例 2 において、過冷却用熱交換器 12 から圧縮機 1 の吸入配管 2-6 へ導かれる第 2 の連結配管 15 と圧縮機 1 の吸入配管 2-6 の合流部に、圧力検出器 17 と温度検出器 18 を備えたものである。

【0030】次に動作について図 7 および図 8 において説明する。配管 2-4 より分岐された過冷却液の一部が、第 2 の減圧装置 14 により絞られ、過冷却用熱交換器 12 により室外熱交換器 4 により凝縮された液冷媒を冷却し、圧縮機 1 へ戻される際に、前記圧力検出器 17 と温度検出器 18 により検出された圧力と温度から算出される冷媒の過熱度が目標値となるように、第 2 の減圧装置 14 の絞り開度を制御する。上記のように、配管 2-4 より分岐される冷媒の流量を調整することにより、圧縮機 1 への液バックを防止し信頼性の向上を図ることができると共に、冷凍サイクルの効率も向上する。

【0031】以上のように、実施例 4 によれば、過冷却用熱交換器 12 から圧縮機 1 の吸入配管へ接続された配管の吸入配管との合流部の圧力と温度を検出することにより、圧縮機 1 への液バックを防ぐことができ、圧縮機 1 の信頼性が向上する。

【0032】実施例 5. この発明の実施例 5 について図 9 を用いて説明する。実施例 2 において、第 1 の連結配管 13 の過冷却用熱交換器 12 へ接続される部分に第 2 の温度検出器 19 を、過冷却用熱交換器 12 から圧縮機 1 の吸入配管 2-6 へ導かれる第 2 の連結配管 15 と圧縮機 1 の吸入配管 2-6 の合流部に、第 1 の温度検出器 18 を備えたものである。

【0033】次に動作について図 9 および図 10 において説明する。第 2 の温度検出器 19 により検出された冷媒の飽和温度と第 1 の温度検出器 18 により検出された温度から算出される冷媒の過熱度が目標値となるように、第 2 の減圧装置 14 の絞り開度を制御する。上記のように、安価な温度検出器（例えばサーミスタなど）を使用することにより容易に、圧縮機 1 への液バックを防止し信頼性の向上を図ることができると共に、冷凍サイクルの効率も向上する。

【0034】この実施例 5 によれば、減圧装置により膨張された冷媒の温度と過冷却用熱交換器から圧縮機 1 の吸入配管へ接続された配管の吸入配管との合流部の温度を検出することにより、安価で圧縮機への液バックを防ぐことができ、圧縮機 1 の信頼性が向上する。

【0035】

【発明の効果】請求項 1 の空気調和機は、圧縮機、四方弁、室外熱交換器、減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記減圧装置と室内熱交換器の間に設けられ、その下部が前記室内熱交換器に接続すると共に、上部が開閉弁及び

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キャピラリーチューブを介して前記圧縮機の吸入側に接続する気液分離器を備えた構成にしたので、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果を確保することにより、冷房能力の低下を防止する。

【0036】請求項2の空気調和機は、圧縮機、四方弁、室外熱交換器、第1の減圧装置、室内熱交換器等を順次環状に接続した冷媒回路を有する空気調和機において、前記室外熱交換器と第1の減圧装置の間に設けられた過冷却用熱交換器と、この過冷却用熱交換器と前記第1の減圧装置の間から分岐し、第2の減圧装置を介して前記過冷却用熱交換器へ接続される第1の連結配管と、前記過冷却用熱交換器から前記圧縮機の吸入側に接続される第2の連結配管と、を備えた構成にしたので、室内熱交換器および延長配管を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐと共に冷凍効果を確保することにより、冷房能力の低下を防止する。

【0037】請求項3の空気調和機は、請求項2記載の空気調和機において、室外熱交換器と過冷却用熱交換器の間に第3の減圧装置を備えた構成にしたので、室外熱交換器を流れる冷媒の流速を抑えることにより管内圧損の増大を防ぐことができ、暖房能力の低下を防止できる。

【0038】請求項4の空気調和機は、請求項2記載の空気調和機において、第2の連結配管と圧縮機の吸入側との合流部に設けられた圧力検出器及び温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えた構成にしたので、圧縮機への液バックを防ぐことができ、圧縮機の信頼性が向上する。

【0039】請求項5の空気調和機は、請求項2記載の空気調和機において、第2の連結配管と圧縮機の吸入側との合流部に設けられた温度検出器と、第1の連結配管と過冷却用熱交換器の接続部に設けられた第2の温度検出器と、前記合流部の冷媒過熱度が目標値になるように第2の減圧装置の開度を調整する手段と、を備えた構成にしたので、安価で容易に、圧縮機への液バックを防ぐことができ、圧縮機の信頼性が向上する。

【図面の簡単な説明】

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【図1】この発明による実施例1の冷媒回路図である。

【図2】この発明による実施例1の動作を示すモリエル線図である。

【図3】この発明による実施例2の冷媒回路図である。

【図4】この発明による実施例2の動作を示すモリエル線図である。

【図5】この発明による実施例3の冷媒回路図である。

【図6】この発明による実施例3の動作を示すモリエル線図である。

10 【図7】この発明による実施例4の冷媒回路図である。

【図8】この発明による実施例4のフローチャート図である。

【図9】この発明による実施例5の冷媒回路図である。

【図10】この発明による実施例5のフローチャート図である。

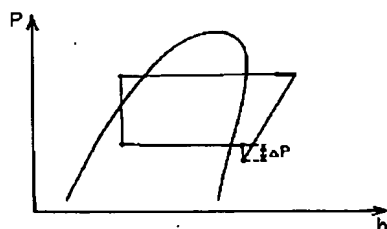
【図11】従来の空気調和機の冷媒回路図である。

【図12】従来の空気調和機の動作を示すモリエル線図である。

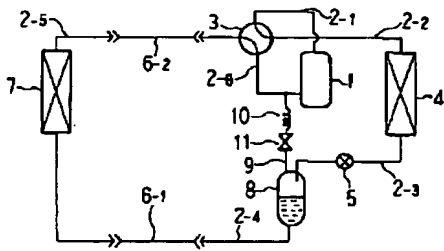
【符号の説明】

- | | |
|----|------------|
| 1 | 圧縮機 |
| 2 | 冷媒配管 |
| 3 | 四方弁 |
| 4 | 室外熱交換器 |
| 5 | 第1の減圧装置 |
| 6 | 延長配管 |
| 7 | 室内熱交換器 |
| 8 | 気液分離器 |
| 9 | 連結配管 |
| 10 | キャピラリーチューブ |
| 11 | 開閉弁 |
| 12 | 過冷却用熱交換器 |
| 13 | 第1の連結配管 |
| 14 | 第2の減圧装置 |
| 15 | 第2の連結配管 |
| 16 | 第3の減圧装置 |
| 17 | 圧力検出器 |
| 18 | 第1の温度検出器 |
| 19 | 第2の温度検出器 |

【図12】

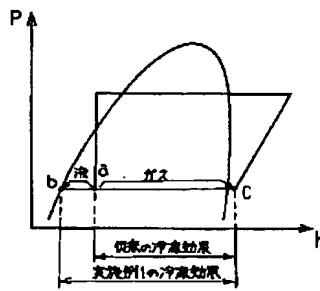


【図1】

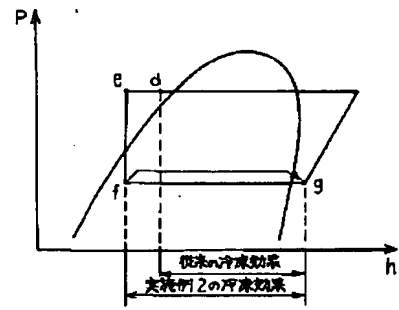


- 1: 圧縮機 5: 第1の減圧装置 9: 連結配管
2: 冷凝配管 6: 延長配管 10: キャピラリーチューブ
3: 四方弁 7: 室内熱交換器 11: 開閉弁
4: 室外熱交換器 8: 気液分離器

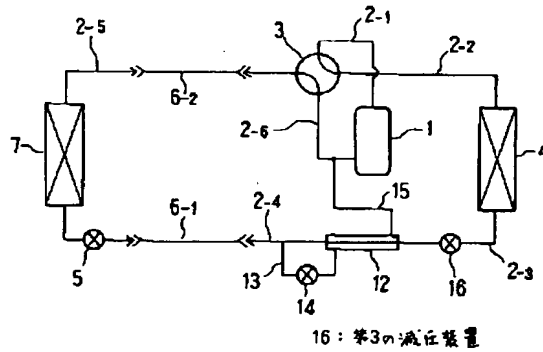
【図2】



【図4】

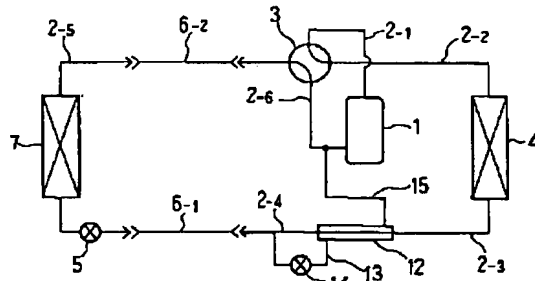


【図5】



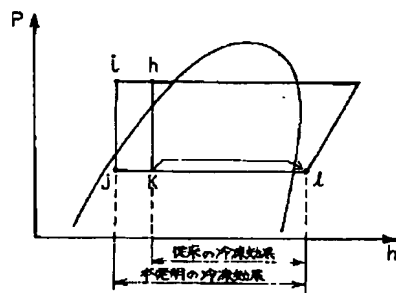
- 16: 第3の減圧装置

【図3】

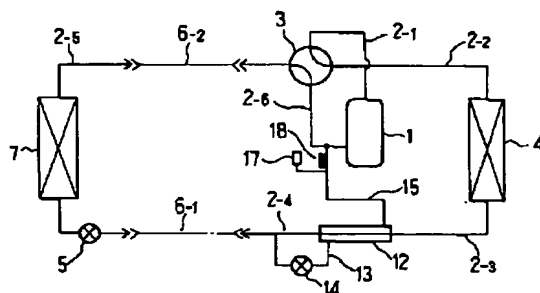


- 12: 過冷却用熱交換器
13: 第1の連結配管
14: 第2の減圧装置
15: 第2の連結配管

【図6】

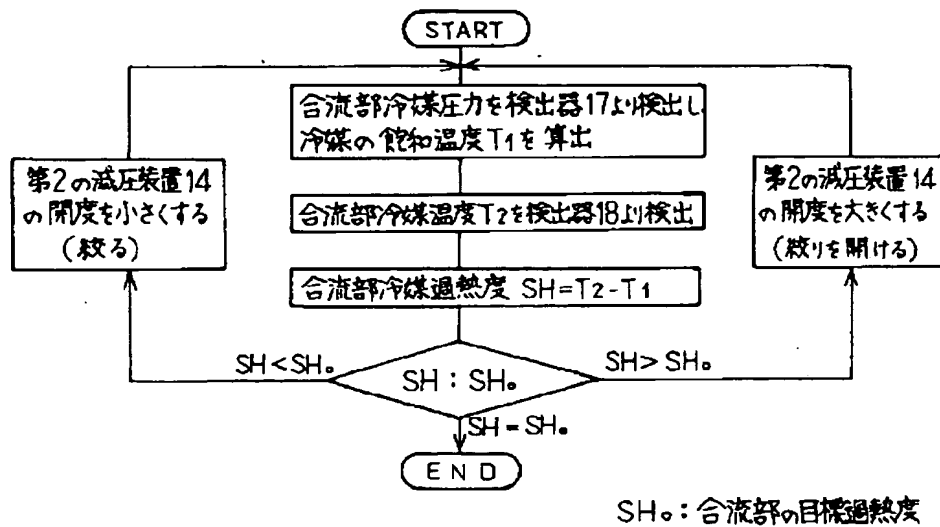


【図7】

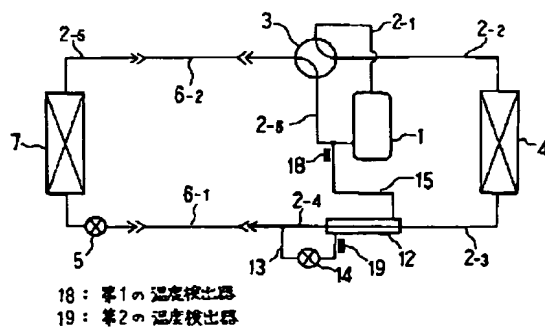


- 17: 圧力検出器
18: 温度検出器

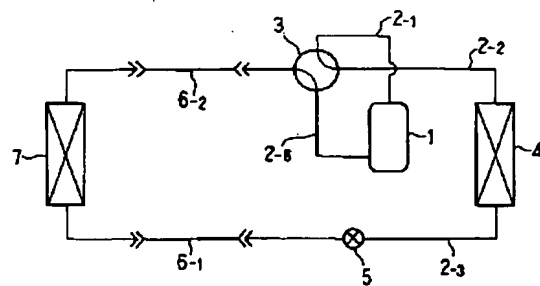
【図8】



【図9】



【図11】



【図10】

SH₀: 合流部の目標過熱度